A CLOSER LOOK

…at Florida Bay Research

This is a view of the coast of Florida Bay, looking northward toward the Everglades. The boundary is a salinity transition zone that is covered by ponds, streams and mangrove wetlands. The District is researching how changing water management affects the ecology of this highly productive zone.

Florida Bay is a subtropical estuary averaging 3 feet in depth

Between the southern edge of the Everglades and the Florida Keys lies a large, shallow, subtropical estuary called Florida Bay. This bay is triangular in shape, with about 80 percent of its 850 square miles within the boundaries of Everglades National Park. Because its average depth is only about 3 feet, sunlight can readily reach the bottom and support the growth of seagrass beds. These grass beds are an excellent habitat for a wide diversity of fish. Until recently, Florida Bay was characterized by its clear, warm waters, lush seagrass beds and outstanding fishing.

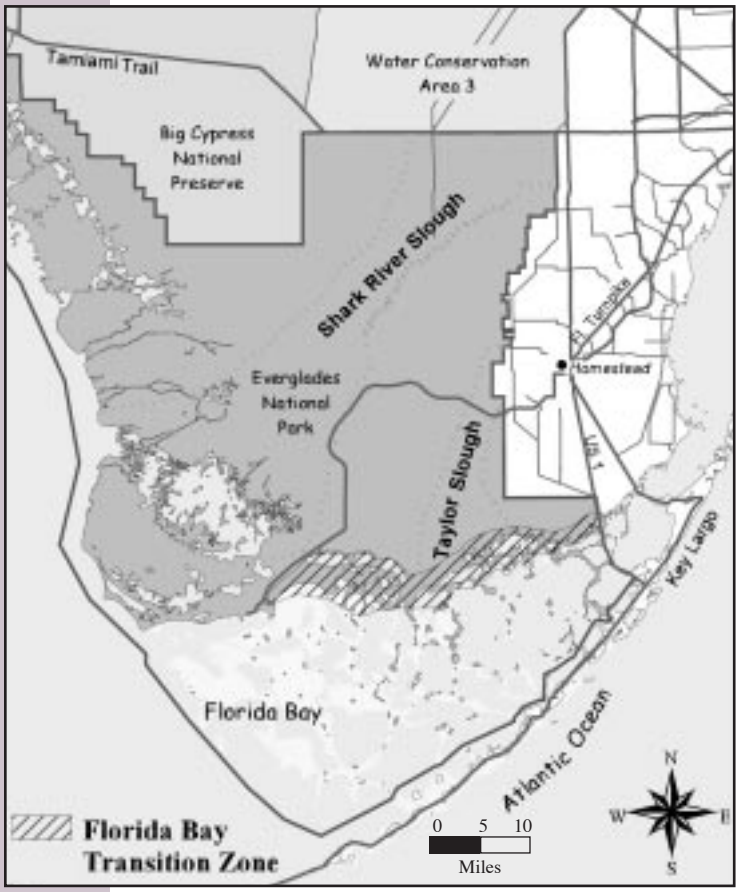
However, starting in the 1980s, dramatic changes in the ecology of Florida Bay became evident. These changes included the widespread death of seagrass beds, turbid water associated with this die-off, the occurrence of large and sustained blooms of algae in the water and the death of sponges near the Florida Keys. Another apparent change has been the decline in the yield of commercial and recreational fisheries over several decades. These observations have prompted many concerned citizens to conclude that Florida Bay is dying.

With widespread recognition of Florida Bay's ecological changes, the state of Florida and the federal

In review…

- The District is working within a collaborative interagency framework to restore Florida Bay.
- Restoration targets are being defined by interpreting historical records preserved in the bay's sediments and corals.
- Studies are analyzing how changing freshwater flow affects Florida Bay nutrient inputs and seagrass health.
- Scientists are focusing on the region most affected by water management – the salinity transition zone between Florida Bay and the Everglades.

government made a commitment to improve environmental management in order to restore the bay toward a more natural state. Florida passed legislation in 1994 directing the District to modify the quantity, quality, timing and distribution of water delivered to Florida Bay to bring about its restoration. However, when an independent panel of experts assessed scientific understanding of the bay in 1993, the panel concluded that people could not yet effectively restore the bay, because they lacked knowledge of the bay's natural, historical condition and lacked knowledge of why the bay had changed. The common perception that the bay's problems could be attributed to a single cause – high salinity that resulted from the diversion of freshwater away from the bay via canals – could not be substantiated.



Florida Bay is a shallow estuary at the southern tip of the Florida peninsula. Freshwater flows to the bay through two waterways in the Everglades National Park's wetlands – Taylor Slough and Shark River Slough. Efforts are currently under way to restore natural patterns of water flowing through the wetlands and to the bay.

This independent scientific assessment of what has happened to the ecology of Florida Bay and how to fix it was a strong incentive for a collaborative interagency research program. With partners from other state and federal agencies, District researchers began a comprehensive investigation of the bay to better understand the ecological consequences of alternative environmental management actions.

Florida Bay is a shallow estuary that is connected to the Everglades by the flow of freshwater. At the boundary between the wetland and the estuary, seedlings of mangrove trees sprout, forming a productive habitat for many fish.

The District's research focus relates to water management

Within the framework of the collaborative interagency research program, the District's research efforts are distinct from, but complementary to, the efforts of other state and federal agencies. The District is concentrating on providing answers to two questions that are directly related to water management:

1) What was the natural, historical condition of Florida Bay, particularly with regard to the range and variability of salinity?

2) What is the effect of changing the flow of freshwater and its associated nutrients on the Florida Bay ecosystem?

Answering the first question will help define the meaning of restoration in Florida Bay, and answering the second question will provide a scientific basis for the public and environmental managers to decide the future state of the bay.

> With widespread recognition of Florida Bay's ecological changes, the state of Florida and federal government made a commitment to improve environmental management in order to restore the bay.

Many scientists are helping to determine Florida Bay's environmental history. The District works with and supports scientists from the University of Miami, Florida International University, Florida Atlantic University and the U.S. Geological Survey who are

Here is a cross-section of a coral head from Florida Bay. This image, taken with X-rays, shows the coral skeleton's rings. A ring is deposited during each year of growth and, thus, can be dated. Chemical analysis of a ring reveals the salinity conditions of the bay during the year it was deposited. (Photo courtesy of P. Swart.)

studying both Florida Bay and the wetlands adjacent to the C-111 canal. In these studies, scientists are making a variety of chemical and biological measurements within the sediments and skeletons of corals to reconstruct the variations of the bay's salinity during the past 100 to 200 years. Such reconstructions are possible using corals because when corals grow, they deposit skeleton layers in annual rings that can be counted and dated. Because researchers know when a given ring was deposited, and that the chemistry in this ring reflects the chemistry of water at the time it was deposited, they can infer what Florida Bay water was like in the past.

Using this approach, scientists have determined that the average salinity of bay waters during the 1800s was lower than in the 1900s, and salinity was more variable year to year in the 1800s than the 1900s. Perhaps the most striking finding was that the bay's salinity regime was strongly changed by construction of the Flagler railway around 1910, prior to major canal construction efforts in south Florida. With railway construction, many passes between the Keys were filled, cutting off water circulation.

The District is also researching the historical record preserved in the bay's sediments. Historical reconstructions from sediments are possible because sediments in a few areas of the bay were deposited and remain in undisturbed layers that can be dated using several different techniques. Finding these undisturbed areas and confirming the dates of sediment layers required two years of collecting and analyzing sediment cores from throughout the bay. Scientists are now analyzing a suite of environmental indicators of not only historical salinity of the bay, but also the historical status of nutrients, seagrasses and algal blooms. Preliminary results seem to confirm the results from the coral study. Salinity appears to have increased not only because of canal construction, but also because of the railway.

Scientists are collecting nutrient samples near the mouth of a mangrove creek that flows into Florida Bay. Scientists from the District are working with others from several universities and the USGS to determine how changing freshwater flow to Florida Bay is affecting the water quality of the bay.

Research will reveal the effects of changes in freshwater inflows

Florida Bay is connected to the Everglades by the flow of freshwater into the bay and the infiltration of salt

PARTNERSHIPS IN RESEARCH

- Florida Atlantic University
- Florida Center for Environmental Studies
- Florida Department of Environmental Protection
- Florida International University
- Louisiana State University
- Miami-Dade County Department of Environmental Resources Management
- National Audubon Society
- National Oceanic & Atmospheric Administration
- National Park Service
- University of Florida
- University of Miami
- U.S. Army Corps of Engineers
- U.S. Environmental Protection Agency
- U.S. Geological Survey

District research is determining how changing freshwater flow affects the cycling of nutrients and growth of seagrasses in Florida Bay. Here, a District researcher collects a sample from a submerged chamber that covers part of a seagrass bed in northern Florida Bay.

water into the Everglades. The boundary between these two ecosystems is the salinity transition zone, an area dominated by mangrove wetlands and coastal bays and ponds that contain productive and diverse seagrass beds. The District is focusing research in this transition zone, because the area is sensitive to water management changes. It is here that scientists can most easily determine the effect of changing salinity on seagrass communities and the effects of increasing freshwater flow on the nutrient inputs and cycles that drive much of the bay's ecology, including the occurrence of algae blooms.

In order to study such a large and complex portion of the Everglades-Florida Bay landscape, the District is collaborating with many research partners. Scientists are measuring the flow of freshwater and associated nutrients into the bay. Furthermore, they are conducting experiments on how changing salinity affects nutrient cycling.

This nutrient research is coordinated with experiments on plants, including both mangrove trees and seagrasses. In particular, the District is developing an experimental facility at Everglades National Park's Key Largo station that will enable researchers to test the effect of different salinity levels and fluctuations on the health of seagrass. The results of this research will then be integrated by computer models, which will help provide predictions that will enable the District to more wisely manage south Florida water resources.

> Florida Bay is connected to the Everglades by the flow of freshwater into the bay and the infiltration of salt water into the Everglades.

District researchers in the mangrove wetlands near the northern coast of Florida Bay are preparing to set up a device that precisely measures changes in the elevation of the wetland surface. The device is being used to determine how changing water management affects natural barriers that prevent the intrusion of salt water into the Everglades.

What's ahead…

- Compile results from research on Florida Bay's historical environmental conditions and provide recommendations for salinity and freshwater input restoration targets.
- Assess how changing water management affects the flow of nutrients into Florida Bay as well as the cycling and availability of nutrients within the southern Everglades and the bay.
- Determine how changing salinity affects the health of Florida Bay's seagrasses.
- Predict Florida Bay's responses to varying the quantity, quality, timing and distribution of freshwater delivered to the bay.

For more information on Florida Bay Research, please contact the SFWMD at (561) 686-8800.

For news on other SFWMD research projects, please see the following *Closer Look* publications:

- An Overview of Current SFWMD Research
- Estuary Research
- Everglades Research
- Kissimmee River Research
- Lake Okeechobee Research
- Stormwater Treatment and Supplemental Technology Research